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Two new species of *Tuber* from China

Li Fan[1*], Jin-Zhong Cao[2], Yan-Yun Liu[1], & Yu Li[2*]

[1] *College of Life Science, Capital Normal University, Xisanhuanbeilu 105, Haidian, Beijing 100048, China*

[2] *Institute of Mycology, Jilin Agricultural University, Changchun 130118, China*

Correspondence to *: [1] *fanli@mail.cnu.edu.cn* & [2] *yuli966@126.com*

Abstract — Two new species of the genus *Tuber* are described from China. *Tuber lijiangense* is differentiated from other brown species mainly by its globose ascospores with a lower reticulated ornamentation, and *T. sinoexcavatum* is distinguished from *T. excavatum* by its globose ascospores.

Key words — *Ascomycota*, *Tuberaceae*, truffle

Introduction

The genus *Tuber* F.H. Wigg. is an important group of fungi, both ecologically and commercially. All species of the genus form ectomycorrhizal (EM) symbiosis with many important timber and nut tree species (Gregory et al. 2009), and some species are frequently sought after for culinary and medical purposes around the world. *Tuber* is a relatively large genus, containing around 100 species and being widely distributed throughout the northern hemisphere, of which near half appear to be endemic to North America and about 33 species are recognized from Europe (Gregory et al. 2009).

Since the first description of the genus in China by Liu (1985) with *T. taiyuanense*, more than 20 *Tuber* species have been reported from China (Cao 2010). Some of these species have already become a good business on both domestic and international markets. The evident importance of the genus in both biodiversity and economy has stimulated more investigations *Tuber* in China. In this paper two new *Tuber* species are described and illustrated.

Materials & methods

One *Tuber* species that had been collected in Yunnan Province was discovered after the dried specimens had been deposited in HKAS (Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Science). The specimens of the other samples

studied were newly collected in Sichuan Province and are deposited in BJTC (Herbarium Biology Department, Capital Normal University). The macroscopic characteristics were described from both fresh and rehydrated specimens. The microscopic characteristics were described from razor-blade sections mounted in 3%KOH, Melzer's reagent, or cotton blue. For scanning electron microscopy (SEM), ascospores were scraped from the dried gleba of fruitbodies and mounted in distilled water on a cover glass. After air drying the cover glasses were directly attached to a SEM stub with doubled-sided tape, and then coated with gold-palladium. The treated materials were examined and photographed with a HITACHI S-4800 SEM.

Taxonomy

Tuber lijiangense L. Fan & J.Z. Cao, **sp. nov.** Figs 1–5

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Ascomata ochracea vel bruneola, 0.5–3 cm diam, subglobosa vel globosa irregulara lobata, primitus brevi-pubeula. Peridium 250–350 μm crassum, stratis duobus: stratum exterius pseudoparenchymaticum, stratum interius hyphi intertextis. Gleba solida, bruneola vel purpureobruneola, veins albis. Asci spori 1–2(–3), 60–90 × 50–80 μm. Ascosporae globosa, ochraceae, 25–42.5 μm, reticulatae.

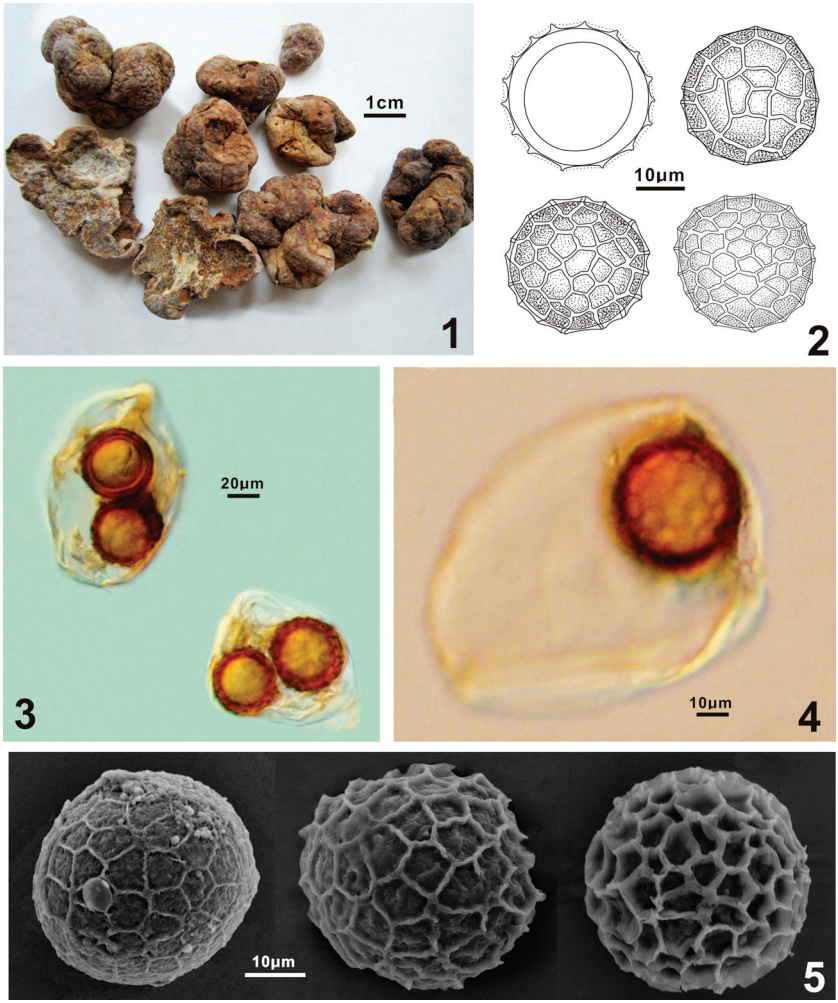
Type: Juan Chen 404 (HKAS 52005, **holotype**), 29 Oct. 2006, Yongsheng county, Lijiang city, Yunnan Province, China, under *Pinus yunnanensis* Franch. (*Pinaceae*).

Etymology: *lijiangense* (Lat.), refers to the type locality.

Ascomata hypogeous, subglobose to irregularly lobed, with shallow to deep furrows, 0.5–3 cm in diam., pale yellow or light brown when fresh, pubescent. Odor faint when fresh. Peridium 250–350 μm thick with two layers; outer layer 60–100 μm thick, pseudoparenchymatous, composed of subglobose or subangular, light brown cells 7.5–25 μm in diam.; inner layer 190–250 μm thick, hyaline, of intricately interwoven hyphae with thin-walled cells, 2.5–5(–7.5) μm broad. Hairs abundant, composed of hair-like hyphae, arising from the superficial cells, 60–100 μm long and 2.5–5 μm broad at base, tapered, usually acute at apex, 1–2 septate. Gleba whitish when young, brown or purple brown at maturity, veins white, narrow and numerous. Asci globose to subglobose, 60–90 × 50–80 μm, sessile or with a short stalk, 1–2(–3) spores. Ascospores globose, hyaline at first, brown or yellow brown at maturity, alveolate reticulum, 25–42.5 μm excluding the ornamentation, the walls up to 2.5–5 μm thick, the meshes complete, five or six sided, regular to irregular, lower, usually less than 2 μm deep, and fewer ascospores trending to be smooth walled, (3–)4–8(–12) meshes across the spore width.

Ecology, Distribution — Hypogeous, under *Pinus yunnanensis*. Known from Yunnan Province, China.

Comments — The most distinctive morphological characteristics of *T. lijiangense* that separate it from the other *Tuber* species are the ornamentation of its ascospores, which are typically reticulate but with meshes that are



Figs 1–5. *Tuber lijiangense* (HKAS 52005, holotype). 1. Ascocarps. 2. Ascospores. 3–4. Asci and ascospores observed under light microscope. 5. Ascospores observed under the scanning electronic microscope. Bars: 1 = 1 cm; 2, 4, 5 = 10 μm; 3 = 20 μm.

much lower (normally < 2 μm in depth) and walls that are sometimes almost smooth in some spores. To our knowledge, no other *Tuber* species has this type of ascospore. Furthermore, the number of ascospores per ascus in this species is also peculiar, usually 1–2 spores in most asci, instead of 1–4(–5) spores in most other species.

Globose ascospores are not common in *Tuber*, although one North American species with globose spores, *T. californicum* Harkn., seems to be common in Northern China (Gilkey 1954a,b; Wang 1988). It can easily be distinguished from *T. lijiangense* by the distinctive and regular reticulate ascospore ornamentation.

Tuber sinoexcavatum L. Fan & Yu Li, **sp. nov.** Figs 6–9

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Ascomata bruneola, excavatum, 1.5–3 cm diam, subglobosa vel globosa irregulara. Peridium 200–300 µm crassum, stratis duobus: stratum exterius pseudo–parenchymaticum, stratum interius hyphi intertextis. Gleba solida, purpureo-rufo-bruneola, veins albis. Asci spori (1–)2–3(–4), 75–125 × 62.5–100 µm. Ascosporae subglobosa vel lato-ellipsoideae, ochraceae, 35–50 × 30–45 µm, reticulatae.

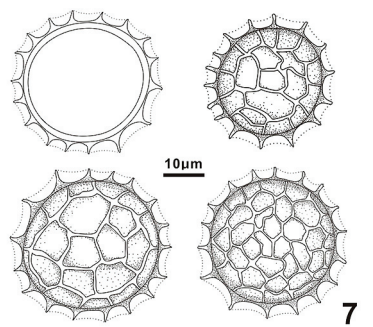
Type: De-fu Liu (BJTC FAN130, **holotype**), 20 Dec. 2007, China, Sichuan Province, Panzhihua city, under the soil of *Pinus* sp.

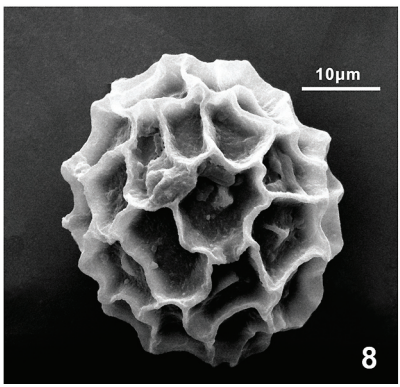
Etymology: *sinoexcavatum* (Lat.) = the endemic Chinese species that is similar to *T. excavatum*.

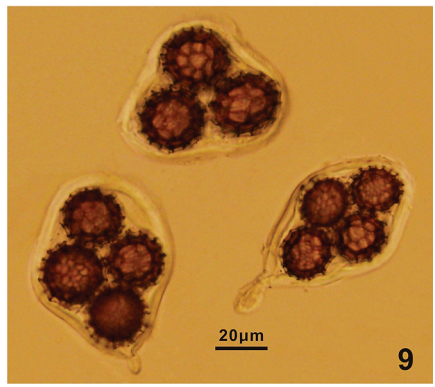
Ascomata hypogeous, subglobose or depressed, with a typical basal cavity (excavated ascomata), 1.5–3 cm in diam., pale yellow brown to brown when fresh, smooth or minutely papillose, distinctly verrucose at the surface of cavity area. Peridium 200–300 µm thick with two layers; outer layer 40–100 µm thick, pseudoparenchymatous, composed of subglobose or subangular, light brown cells 5–15 µm in diam.; inner layer 160–200 µm thick, hyaline, of intricately interwoven hyphae with thin-walled cells 2.5–5 µm broad. Gleba yellow brown or red brown at maturity, veins white, narrow and numerous. Asci globose or subglobose, 75–125 × 62.5–100 µm, with a short stalk, (1–)2–3(–4) spores. Ascospores globose, hyaline at first, brown or yellow brown at maturity, alveolate reticulum, 35–50 × 30–45 µm excluding the ornamentations, meshes 5 µm deep and 7.5–15 µm in diam., 3–5 meshes across the spore width.

Ecology, Distribution — Hypogeous, under the soil of *Pinus* sp. Known from Sichuan Province, China.

Comments — This species is very similar to *T. excavatum* Vittad., which is very common in Europe (Lange 1956). It has globose to subglobose ascospores, and its gleba is usually dark at maturity. Another European species, *T. fulgens* Quél. (Lange 1956), also has the same type of ascospores, but it differs from *T. sinoexcavatum* by ascomata that are orange-brown and hollowed with a small hole leading to the outside. *Tuber pseudoexcavatum,* a popular species in southwestern China (Wang et al. 1998) which also produces typically excavated ascomata, is easily distinguished from *T. sinoexcavatum* by the brown or dark brown, verrucose ascomatal surface and the ascospores with clearly distinct spino-reticulate ornamentations.







Figs 6–9. *Tuber sinoexcavatum* (BJTC FAN130, holotype). 6. Ascocarps. 7. Ascospores. 8. Ascospore observed under the scanning electronic microscope. 9. Asci and ascospores observed under light microscope. Bars: 6 = 1 cm; 7, 8 = 10 μm; 9 = 20 μm.

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